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## Research Brief for Forest Managers

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### Charcoal Carbon Formation from Prescribed Burning

Wildfire frequency and severity in the western United States has increased as a result of fire suppression, increasing temperature, and prolonged drought. Forest thinning and prescribed burning reduce high-severity fire risk, but require removal and emissions of carbon. However, during each fire event a fraction of the burning vegetation and soil organic matter is converted into charcoal, a stable carbon (C) form, which may persist on the landscape. Charcoal is formed from the incomplete combustion of organic matter and/or woody debris. In this study we sought to determine the charcoal C contribution from the incomplete combustion of fine woody debris and coarse woody debris after a prescribed burn.

At the Teakettle Experimental Forest we sampled charcoal in the organic matter (litter & duff) and top 5 cm of mineral soil adjacent to and on a perpendicular transect away from coarse woody debris (CWD) in treatments that had been burned in 2001. Our results indicated that there was no difference in the amount of charcoal C produced from coarse woody debris and fine woody debris.



Charred log at the Teakettle Experimental Forest

We also compared treatment effects on charcoal production and found that the burn-only, understory-thin and burn, and overstory-thin and burn treatments had significantly more charcoal carbon than the control (Fig. 1). Relative to other C pools, charcoal produced from one prescribed fire represents a small fraction of total ecosystem C (<1%). However, given the stable nature of charcoal C, we expect this C form to accumulate with subsequent burns.

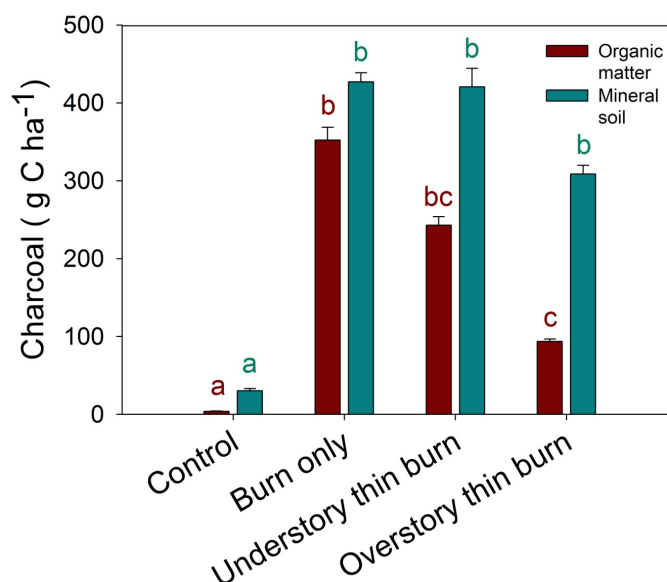


Figure 1. Charcoal C amount in the different treatments and soil layers. Same colored bars with different letters are significantly different ( $p \leq 0.05$ ).

The last fire at the Teakettle Experimental Forest occurred in 1865. The amount of charcoal found in the control provides evidence that charcoal can persist in this system for a considerable period of time.

#### Management Implications:

- Fuel reduction treatments that include prescribed burning increase charcoal C production.
- Charcoal produced from a single prescribed burn accounts for less than 1% of the total ecosystem C.
- A simple mass-balance approach to estimate emissions from fire may yield an overestimate of emissions and an underestimate of post-fire total ecosystem C.

#### References:

Wiechmann, M.L., M.D. Hurteau, J.P. Kaye, J.R. Miesel. 2015. Macro-particle charcoal C content following prescribed burning in a mixed-conifer forest, Sierra Nevada, California. PLoS ONE 10(8): e0135014.

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